REMARKS

Applicants respectfully request reconsideration and further examination of the present application.

I. Amendments to the Claims

Prior to this Amendment A, claims 1-73 were pending. With this Amendment, claims 1, 10, 20-22, 26-29, 40, 44, 49, 53, 57, 65, 66 and 70 have been amended, while claims 74-77 have been added. Accordingly, claims 1-77 are now pending.

Claims 10, 20-22, 26-29, 40, 44, 49, 53, 65, 66 and 70 have been amended for purposes of clarification only. More specifically, these claims have been amended simply to correct typographical errors, to provide greater clarity, and/or to ensure proper antecedent basis is present therein. In particular, claims 49 and 53 have been amended to clarify that the covalently cross-linked polymer electrolyte comprises labile protons in the absence of a protic solvent. Support for this clarifying amendment may be found in the specification, for example, on page 35, lines 3-12.

Claims 1 and 57 have also been amended to ensure proper antecedent basis is present therein. Additionally, claims 1 and 57 have been amended to more particularly claim certain preferred embodiments of the present invention, these claims now requiring that the cross-linked polymer electrolyte be inert to lithium. Support for this amendment may be found in the specification, for example, on page 18, line 27 to page 19, line 4.

Finally, new claims 74-77 have been added. Support for these claims may be found in the specification, for example, on page 19, lines 4-9.

II. Rejections under 35 U.S.C. §102(b)

Reconsideration of the present rejections under 35 U.S.C. §102(b) is respectfully requested, in as much as Applicants respectfully submit that each and every element as set forth in the rejected claims is not described in a single prior art reference, as further detailed below.

A. The Claimed Subject Matter

Claim 1, from which claims 2-39 and new claims 74 and 75 depend, is directed to a covalently cross-linked polymer electrolyte. The polymer electrolyte comprises a polymer backbone containing amine groups, a cross-linker, and a dissolved or dispersed metal salt, wherein the <u>cross-linked polymer electrolyte is inert to lithium</u>. As noted in the specification on page 18, line 27 to page 19, line 2, a cross-linker is selected to yield a cross-linked polymer electrolyte that is inert to, or even acts to enhance, ion transport there through.

Claim 40, from which claims 41-48 depend, is also directed to a covalently cross-linked polymer electrolyte. The polymer electrolyte comprises a polymer backbone containing amine groups, a cross-linker, and <u>one or more solvent moieties covalently bound thereto</u>. As noted in the specification on page 31, line 18, to page 32, line 6, "solvent moiety" refers to a solvent molecule, or a portion thereof (i.e., a solvent residue), which has been covalently bound to the polymer. This moiety enables a metal salt to be solublized or dispersed within the polymer electrolyte without the need of a swelling solvent. As a result, a "dry" polymer electrolyte is formed, which acts to eliminate the leakage problems of conventional electrolytes.

Claim 49, from which claims 50-52 depend, is also directed to a covalently cross-linked polymer electrolyte. The polymer electrolyte comprises a polymer backbone containing amine groups, a cross-linker, and <u>labile protons</u> therein <u>in the absence of a protic solvent</u>. As noted in the specification on page 35, lines 3-12, the amine group

nitrogens of the present polymer electrolytes may form primary, secondary, or tertiary ammonium salts, as a result of, for example, polymerization, substitution, cross-linking, etc., at the nitrogen atoms. In such instances, the present polymer electrolytes, and more specifically the amine group nitrogen atoms, are inherently protonated; that is, protons are inherently present within the polymers, rather than being introduced by means of the addition of a protic solvent.

Claim 53, from which claims 54-56 depend, is directed to a fuel cell which comprises a proton-conducting, covalently cross-linked polymer electrolyte membrane, an anode in contact with a first side of the membrane, and a cathode in contact with a second side of the membrane which is opposite the first. Much like claim 49, the covalently cross-linked polymer electrolyte membrane comprises a polymer backbone containing amine groups, a cross-linker, and labile protons therein in the absence of a protic solvent.

Claim 57, from which claims 58-60 and new claims 76 and 77 depend, is directed to a battery which comprises a negative electrode, a positive electrode, and an ionically conductive polymer electrolyte disposed there between and in contact therewith. The polymer electrolyte, much like claim 1, is covalently cross-linked and comprises a polymer backbone containing amine groups, a cross-linker, and a dissolved or dispersed metal salt, the cross-linked polymer electrolyte being inert to lithium.

Claim 61, from which claims 62-65 depend, is directed to a gradient battery comprising a <u>continuous, covalently cross-linked poly(amine) film</u>, the polymer film comprising metal ions, a negative electrode region, a positive electrode region, and an electrolyte region dispose there between which, during charge or discharge of the battery, enable the passage of metal ions or protons from one electrode to the other. As noted in the present specification on page 42, lines 1-14, the gradient battery of the present invention is <u>a battery having a single, unitary cell structure</u>. Therefore, as illustrated in Figure 3, the claimed battery <u>does not have the large or macro-scale</u>

interfaces between the anode, electrolyte and cathode, which are present in conventional batteries. These large or macro-scale interfaces are a well-recognized problem associated with the conductivity and performance of conventional batteries.

Claim 66, from which claims 67-69 depend, is directed to a covalently cross-linked polymer single ion electrolyte. The polymer electrolyte comprises a polymer backbone containing amine groups, a cross-linker, and an ion pair, one member of the pair being covalently attached to the polymer backbone and the other being capable of diffusing through the polymer electrolyte upon the application of an electric field. As noted in the present specification on page 39, lines 4-20, conductivity in a single ion electrolyte is achieved by the movement of the cations or anions in the system, the corresponding counter-ions being part of the polymer itself and thus not being mobile. Such an electrolyte is prepared by having an ionic substituent covalently attached to the polymer backbone. This electrolyte is notably different from conventional "two ion" electrolytes, wherein both cations and anions from a metal salt move through the system, resulting in unfavorable segregation of positive and negative ions, when used.

Claim 70, from which claims 71-73 depend, is directed to an electrolytic cell which comprises an anode, a cathode, and a covalently cross-linked polymer single ion electrolyte. The polymer electrolyte, much like claim 66, comprises a polymer backbone containing amine groups, a cross-linker, and an ion pair, one member of the pair being covalently attached to the polymer backbone and the other being capable of diffusing through the polymer electrolyte upon the application of an electric field.

B. Harris et al.

Reconsideration is respectfully requested of the rejection of claims 1, 4-10, 30-32, 34, 37-39, 49 and 53-73 under 35 U.S.C. §102(b) as being anticipated by C. Harris et al., "Ionically Conductivity in Branched Polyethylenimine-Sodium Trifluoromethane-sulfonate Complexes . . . " (hereinafter "Harris et al.").

Harris et al. fail to disclose a polymer electrolyte which satisfies each of the requirements of claim 1, or claim 49. More specifically, and contrary to the Office's assertion, Harris et al. fail to disclose a polymer electrolyte that is covalently cross-linked. In fact, they fail to even reference cross-linking. Accordingly, they also fail to disclose a covalently cross-linked polymer electrolyte which is inert to lithium. Rather, Harris et al. disclose only branched and linear polyethylenimine.

With respect to claim 49, in addition to the fact that Harris et al. fail to disclose a covalently cross-linked polymer electrolyte, it is also to be noted that they make no reference to labile protons being present therein in the absence of a protic solvent. Furthermore, and contrary to the Office's assertion, it is to be noted that amine groups in polyethylenimine do not inherently form labile protons. Rather, as noted in the present specification, such protons result from, for example, the formation of ammonium salts in the polymer electrolytes.

In view of the foregoing, claims 1 and 49 are submitted as novel over the cited reference because Harris et al. fail to disclose a cross-linked polymer electrolyte, or a cross-liked polymer electrolyte which has labile protons therein. In as much as claims 4-10, 30-32, 34, 37-39, 74 and 75 depend from claim 1, these claims are submitted as novel over the cited reference for at least the same reasons as those noted with respect to claim 1. Although these claims include additional novel features, these features will not be addressed at this time in the interests of brevity.

Claim 53, from which claims 54-56 depend, comprises a proton-conducting, covalently cross-linked polymer electrolyte membrane which has limitations much like those of the polymer electrolyte of claim 49. Accordingly, claim 53, as well as all claims depending therefrom, is submitted as patentable over the cited reference for the same reasons as those set forth with respect to claim 49.

Claim 57, from which claims 58-60 and new claims 76 and 77 depend, is directed to a battery which comprises an ionically conductive polymer electrolyte which

has limitations much like those of the polymer electrolyte of claim 1. Accordingly, claim 57, as well as all claims depending therefrom, is submitted as patentable over the cited reference for the same reasons as those set forth with respect to claim 1.

Claim 61, as well as dependent claims 62-65, are submitted as patentable over the cited reference because, as previously noted, Harris et al. fail to disclose a cross-linked polymer. Furthermore, Harris et al. fail to disclose a battery comprising a continuous, covalently cross-linked poly(amine) film which comprises metal ions, a negative electrode region, a positive electrode region, and an electrolyte region disposed there between. Rather, to the extent they form a battery, it has a conventional design, thus having macro-scale interfaces between the components thereof.

Claim 66, as well as dependent claims 67-69, are submitted as patentable over the cited reference because, as previously noted, Harris et al. fail to disclose a cross-linked polymer. Furthermore, Harris et al. fail to disclose a battery having an ion pair wherein one member of the pair is covalently attached to the polymer backbone while the other is capable of diffusing through the polymer electrolyte upon the application of an electric field. Rather, Harris et al. simply disclose a conventional "two ion" polymer electrolyte.

Claim 70, as well as dependent claims 71-73, is directed to an electrolytic cell which comprises a covalently cross-linked polymer single ion electrolyte which has limitations much like those of the polymer electrolyte of claim 66. Accordingly, claim 70, as well as all claims depending therefrom, is submitted as patentable over the cited reference for the same reasons as those set forth with respect to claim 66.

C. Takahashi et al.

Reconsideration is respectfully requested of the rejection of claims 1, 4, 5, 7, 8, 10, 30-32, 34, 37, 38, 49, 53, 54, 56-58, 60-62, 64-67, 69-71 and 73 under 35 U.S.C.

§102(b) as being anticipated by T. Takahashi et al., "Chemical Modification of Poly(ethylene imine) for Polymeric Electrolyte" (hereinafter "Takahashi et al.").

Takahashi et al. fail to disclose a polymer electrolyte which satisfies <u>each</u> of the requirements of claim 1. More specifically, Takahashi et al. fail to disclose a covalently cross-linked polymer electrolyte which is <u>inert to lithium</u>. Rather, Takahashi et al. cross-link linear polyethylenimine using 1,2,7,8-diepoxyoctane. As noted in the present specification on page 20, lines 3-8, diepoxides, as a result of the cross-linking reaction, form alcohol functionalities which are reducible upon exposure to lithium.

In view of the foregoing, claim 1 is submitted as novel over the cited reference because Takahashi et al. fail to disclose a cross-linked polymer electrolyte which is inert to lithium. In as much as claims 4, 5, 7, 8, 10, 30-32, 34, 37, 38, 74 and 75 depend from claim 1, these claims are submitted as novel over the cited reference for at least the same reasons as those noted with respect to claim 1. Although these claims include additional novel features, these features will not be addressed at this time in the interests of brevity.

Takahashi et al. also fail to disclose a polymer electrolyte which satisfies <u>each</u> of the requirements of claim 49. Specifically, they fail to disclose a <u>covalently cross-linked</u> polymer electrolyte <u>having labile protons therein in the absence of a protic solvent</u>. Contrary to the Office's assertion, amine groups in the cross-linked polyethylenimine prepared by Takahashi et al. do not inherently form labile protons. Rather, as noted in the present specification, such protons result from, for example, the presence of ammonium salts in the polymer electrolytes. Although Takahashi et al. do disclose the formation of ammonium salts within polyethylenimine, this is done using butylbromide or ethylbromide, and with a polymer that is not cross-linked (see, e.g., p. 322, first column).

In view of the foregoing, claim 49 is submitted as novel over the cited reference, because Takahashi et al. fail to disclose a cross-liked polymer electrolyte which has labile protons therein in the absence of a protic solvent.

Claim 53, from which claims 54 and 56 depend, comprises a proton-conducting, covalently cross-linked polymer electrolyte membrane which has limitations much like those of the polymer electrolyte of claim 49. Accordingly, claim 53, as well as all claims depending therefrom, is submitted as patentable over the cited reference for the same reasons as those set forth with respect to claim 49.

Claim 57, from which claims 58, 60 and new claims 76 and 77 depend, is directed to a battery which comprises an ionically conductive polymer electrolyte which has limitations much like those of the polymer electrolyte of claim 1. Accordingly, claim 57, as well as all claims depending therefrom, is submitted as patentable over the cited reference for the same reasons as those set forth with respect to claim 1.

Claim 61, as well as dependent claims 62, 64 and 65, are submitted as patentable over the cited reference because Takahashi et al. fail to disclose a battery as claimed; that is, they fail to disclose a battery comprising a continuous, covalently cross-linked poly(amine) film which comprises metal ions, a negative electrode region, a positive electrode region, and an electrolyte region disposed there between. Rather, to the extent they form a battery, it has a conventional design, thus having macro-scale interfaces between the components thereof.

Claim 66, as well as dependent claims 67 and 69, are submitted as patentable over the cited reference because Takahashi et al. fail to disclose a battery having an ion pair wherein one member of the pair is covalently attached to the polymer backbone while the other is capable of diffusing through the polymer electrolyte upon the application of an electric field. Rather, they simply disclose a conventional "two ion" polymer electrolyte.

Claim 70, as well as dependent claims 71 and 73, are directed to an electrolytic cell which comprises a covalently cross-linked polymer single ion electrolyte which has limitations much like those of the polymer electrolyte of claim 66. Accordingly, claim 70, as well as all claims depending therefrom, is submitted as patentable over the cited reference for the same reasons as those set forth with respect to claim 66.

D. U.S. Patent No. 5,501,919

Reconsideration is respectfully requested of the rejection of claims 1, 4-6, 8-10, 19-22, 25, 30-32, 34, 35, 49-55, 57-59, 61-63, 65-68 and 70-72 under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 5,501,919 (hereinafter "Paul et al.").

Paul et al. fail to disclose a polymer electrolyte which satisfies <u>each</u> of the requirements of claim 1 or 49. More specifically, and contrary to the Office's assertion, Paul et al. fail to disclose a polymer electrolyte that is covalently <u>cross-linked</u>. In fact, they fail to even reference cross-linking. Accordingly, they also fail to disclose a covalently cross-linked electrolyte which is <u>inert to lithium</u>. Rather, Paul et al. simply disclose the preparation of branched polyethylenimine which has a lithium salt therein.

With respect to claim 49, in addition to the fact that Paul et al. fail to disclose a covalently cross-linked polymer electrolyte, it is also to be noted that they make no reference to such a polymer electrolyte which has labile protons therein in the absence of a protic solvent. Furthermore, and contrary to the Office's assertion, it is to be noted that amine groups in polyethylenimine do not inherently form labile protons. Rather, as noted in the present specification, such protons result from, for example, the presence of ammonium salts in the polymer electrolytes.

In view of the foregoing, claims 1 and 49 are submitted as novel over the cited reference because Paul et al. fail to disclose a cross-linked polymer electrolyte, or a cross-liked polymer electrolyte which has labile protons therein in the absence of a protic solvent. In as much as claims 4-6, 8-10, 19-22, 25, 30-32, 34, 35, 74 and 75

depend from claim 1, these claims are submitted as novel over the cited reference for at least the same reasons as those noted with respect to claim 1. Furthermore, in as much as claims 50-52 depend from claim 49, these claims are submitted as novel over the cited reference for at least the same reasons as those noted with respect to claim 1. Although these claims include additional novel features, these features will not be addressed at this time in the interests of brevity.

Claim 53, from which claims 54 and 55 depend, comprises a proton-conducting, covalently cross-linked polymer electrolyte membrane which has limitations much like those of the polymer electrolyte of claim 49. Accordingly, claim 53, as well as all claims depending therefrom, is submitted as patentable over the cited reference for the same reasons as those set forth with respect to claim 49.

Claim 57, from which claims 58, 59 and new claims 76 and 77 depend, is directed to a battery which comprises an ionically conductive polymer electrolyte which has limitations much like those of the polymer electrolyte of claim 1. Accordingly, claim 57, as well as all claims depending therefrom, is submitted as patentable over the cited reference for the same reasons as those set forth with respect to claim 1.

Claim 61, as well as dependent claims 62, 63 and 65, are submitted as patentable over the cited reference because, as previously noted, Paul et al. fail to disclose a cross-linked polymer. Furthermore, Paul et al. fail to disclose a battery comprising a continuous, covalently cross-linked poly(amine) film which comprises metal ions, a negative electrode region, a positive electrode region, and an electrolyte region disposed there between. Rather, to the extent they form a battery, it has a conventional design, thus having macro-scale interfaces between the components thereof.

Claim 66, as well as dependent claims 67 and 68, are submitted as patentable over the cited reference because, as previously noted, Paul et al. fail to disclose a cross-linked polymer. Furthermore, Paul et al. fail to disclose a battery having an ion

pair wherein one member of the pair is covalently attached to the polymer backbone while the other is capable of diffusing through the polymer electrolyte upon the application of an electric field. Rather, Paul et al. simply disclose a conventional "two ion" polymer electrolyte.

Claim 70, as well as dependent claims 71 and 72, are directed to an electrolytic cell which comprises a covalently cross-linked polymer single ion electrolyte which has limitations much like those of the polymer electrolyte of claim 66. Accordingly, claim 70, as well as all claims depending therefrom, is submitted as patentable over the cited reference for the same reasons as those set forth with respect to claim 66.

E. U.S. Patent No. 5,648,186

Reconsideration is respectfully requested of the rejection of claims 1, 5, 6, 8-14, 16-19, 23-26, 29-36, 40-49, 53-55, 57-59, 61-63, 65-68 and 70-72 under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 5,648,186 (hereinafter "Daroux et al.").[1]

Daroux et al. fail to disclose a polymer electrolyte which satisfies <u>each</u> of the requirements of claim 1. More specifically, Daroux et al. fail to disclose a covalently cross-linked polymer electrolyte which is <u>inert to lithium</u>. Rather, Daroux et al. disclose dendrimers of, for example, polyethylenimine, derivatized by growing ethylene oxide arms therefrom (see, e.g., column 7, lines 16-20). Elsewhere, they *generally* disclose the *optional* cross-linking of dendrimers (see, e.g., column 6, lines 25-31). However, the only specific details provided with respect to cross-linking involve the use of hexamethylene diisocyanate (see, e.g., column 7, lines 16-20, as well as Examples 2,

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[1] It is to be noted that paragraph 9 of the present Office action, and the subsequent text related thereto, are confusing because the cited patent number is to Daroux et al., but paragraph 9 references Gao et al., as well (which is actually U.S. Patent No. 5,964,903). In addition, the subsequent text references both Gao (see page 8) and Daroux (see page 9). In view of the column and line number references, it was concluded that this rejection was based on Daroux et al.

4, 12 and 13). Cross-linking using diisocyanates is known to result in the formation of urethane linkages or functionalities, which are reducible by lithium.

In view of the foregoing, claim 1 is submitted as novel over the cited reference, because Daroux et al. fail to disclose a cross-linked polymer electrolyte which is inert to lithium. In as much as claims 5, 6, 8-14, 16-19, 23-26, 29-36, 74 and 75 depend from claim 1, these claims are submitted as novel over the cited reference for at least the same reasons as those noted with respect to claim 1. Although these claims include additional novel features, such as the requirement in claim 9 that the polymer is *branched* poly(ethylenimine) or claim 10 that the cross-linker be attached to the polymer backbone *through* the amine groups therein, these features will not be addressed in detail at this time, in the interests of brevity.

Daroux et al. also fail to disclose a polymer electrolyte which satisfies each of the requirements of claim 40. Specifically, they fail to disclose a polymer electrolyte which comprises a polymer backbone containing amine groups, a cross-linker, and one or more solvent moieties covalently bound thereto. Daroux et al. simply references the conventional use of a solvent or plasticizer to swelling the polymer electrolyte. They make no reference to the covalent attachment of a moiety derived therefrom to the polymer electrolyte.

In view of the foregoing, claim 40, as well as claims 41-48 depending therefrom, are submitted as novel over the cited reference, because Daroux et al. fail to disclose a cross-liked polymer electrolyte which has a solvent moiety covalently bound thereto.

Daroux et al. also fail to disclose a polymer electrolyte which satisfies each of the requirements of claim 49. Specifically, they fail to disclose a covalently cross-linked polymer electrolyte having labile protons therein, in the absence of a protic solvent. Contrary to the Office's assertion, amine groups in the polymer resulting from the cross-linking of polyethylenimine dendrimers derivatized by growing ethylene oxide arms therefrom do not inherently form labile protons. Rather, as noted in the present

specification, such protons result from, for example, the presence of ammonium salts in the polymer electrolytes. Daroux et al. simply do not disclose the formation of ammonium salts within the dendrimers they prepared.

In view of the foregoing, claim 49 is submitted as novel over the cited reference, because Daroux et al. fail to disclose a cross-liked polymer electrolyte which has labile protons therein, in the absence of a protic solvent.

Claim 53, from which claims 54 and 55 depend, comprises a proton-conducting, covalently cross-linked polymer electrolyte membrane which has limitations much like those of the polymer electrolyte of claim 49. Accordingly, claim 53, as well as all claims depending therefrom, are submitted as patentable over the cited reference for the same reasons as those set forth with respect to claim 49.

Claim 57, from which claims 58, 59 and new claims 76 and 77 depend, is directed to a battery which comprises an ionically conductive polymer electrolyte which has limitations much like those of the polymer electrolyte of claim 1. Accordingly, claim 57, as well as all claims depending therefrom, is submitted as patentable over the cited reference for the same reasons as those set forth with respect to claim 1.

Claim 61, as well as dependent claims 62, 63 and 65, are submitted as patentable over the cited reference because Daroux et al. fail to disclose a battery as claimed; that is, they fail to disclose a battery comprising a continuous, covalently cross-linked poly(amine) film which comprises metal ions, a negative electrode region, a positive electrode region, and an electrolyte region disposed there between. Rather, to the extent they form a battery, it has a conventional design, thus having macro-scale interfaces between the components thereof.

Claim 66, as well as dependent claim 68, is submitted as patentable over the cited reference because Daroux et al. fail to disclose a battery having an ion pair wherein one member of the pair is covalently attached to the polymer backbone while

the other is capable of diffusing through the polymer electrolyte upon the application of an electric field. Rather, they simply disclose a conventional "two ion" polymer electrolyte.

Claim 70, as well as dependent claims 71 and 72, are directed to an electrolytic cell which comprises a covalently cross-linked polymer single ion electrolyte which has limitations much like those of the polymer electrolyte of claim 66. Accordingly, claim 70, as well as all claims depending therefrom, is submitted as patentable over the cited reference for the same reasons as those set forth with respect to claim 66.

F. U.S. Patent No. 5,419,984

Reconsideration is respectfully requested of the rejection of claims 1, 2, 5, 8, 10-15, 19, 23-26, 29-32, 34, 35, 40-49, 53, 54, 57, 58, 61, 62, 65-67, 70 and 71 under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 5,419,984 (hereinafter "Chaloner-Gill et al.").

Chaloner-Gill et al. fail to disclose a polymer electrolyte which satisfies <u>each</u> of the requirements of claim 1. More specifically, Chaloner-Gill et al. fail to disclose a covalently cross-linked polymer electrolyte that comprises a polymer backbone containing amine groups, a cross-linker, and a dissolved or dispersed metal salt, the cross-linked polymer electrolyte being inert to lithium. Rather, they disclose a polymer having a *polysiloxane acrylate* backbone, which may *optionally* be copolymerized *or* cross-linked with at least one other polymer precursor, the list of five potential precursors including *only* one which contains an amine (see, e.g., column 3, lines 27-35). Notably, they do not provide a single example of a cross-linked polymer electrolyte having amine groups in the polymer backbone. Accordingly, they also do not provide a single example of such an electrolyte which is inert to lithium.

In view of the foregoing, claim 1 is submitted as novel over the cited reference because Chaloner-Gill et al. fail to disclose a cross-linked polymer electrolyte which

comprises a polymer backbone containing amine groups therein, and one which is inert to lithium. In as much as claims 2, 5, 8, 10-15, 19, 23-26, 29-32, 34, 35, 74 and 75 depend from claim 1, these claims are submitted as novel over the cited reference for at least the same reasons as those noted with respect to claim 1. Although these claims include additional novel features, these features will not be addressed at this time in the interests of brevity.

Chaloner-Gill et al. also fail to disclose a polymer electrolyte which satisfies each of the requirements of claim 40. Specifically, they fail to disclose a polymer electrolyte which comprises a polymer backbone containing amine groups, a cross-linker, and one or more solvent moieties covalently bound thereto. Chaloner-Gill et al. simply reference the conventional use of a solvent or plasticizer to swelling the polymer electrolyte (see, e.g., column 1, lines 45-61 and the Examples). They make no reference to the covalent attachment of a moiety derived therefrom to an amine-containing, cross-linked polymer electrolyte.

In view of the foregoing, claim 40, as well as claims 41-48 depending therefrom, are submitted as novel over the cited reference, because Chaloner-Gill et al. fail to disclose a cross-liked polymer electrolyte which has a solvent moiety covalently bond thereto.

Chaloner-Gill et al. also fail to disclose a polymer electrolyte which satisfies each of the requirements of claim 49. Specifically, they fail to disclose a covalently cross-linked polymer electrolyte which contains amine groups in the polymer backbone and which has labile protons therein, in the absence of a protic solvent. Contrary to the Office's assertion, the presence of amine groups in polyethylenimine does not result in the inherent formation of labile protons therein. Rather, as noted in the present specification, such protons result from, for example, the presence of ammonium salts in the polymer electrolytes. Chaloner-Gill et al. simply do not disclose the formation of ammonium salts within the polymers they prepared. In fact, as previously noted, they

do not even prepare a cross-linked polymer electrolyte having amine groups in the polymer backbone.

In view of the foregoing, claim 49 is submitted as novel over the cited reference, because Chaloner-Gill et al. fail to disclose a cross-liked polymer electrolyte which has labile protons therein.

Claim 53, from which claims 54 depends, comprises a proton-conducting, covalently cross-linked polymer electrolyte membrane which has limitations much like those of the polymer electrolyte of claim 49. Accordingly, claim 53, as well as all claims depending therefrom, are submitted as patentable over the cited reference for the same reasons as those set forth with respect to claim 49.

Claim 57, from which claim 58 and new claims 76 and 77 depend, is directed to a battery which comprises an ionically conductive polymer electrolyte which has limitations much like those of the polymer electrolyte of claim 1. Accordingly, claim 57, as well as all claims depending therefrom, is submitted as patentable over the cited reference for the same reasons as those set forth with respect to claim 1.

Claim 61, as well as dependent claims 62 and 65, are submitted as patentable over the cited reference because Chaloner-Gill et al. fail to disclose a battery as claimed; that is, they fail to disclose a battery comprising a continuous, covalently cross-linked poly(amine) film which comprises metal ions, a negative electrode region, a positive electrode region, and an electrolyte region disposed there between. Rather, to the extent they form a battery, it has a conventional design, thus having macro-scale interfaces between the components thereof.

Claim 66, as well as dependent claim 67, is submitted as patentable over the cited reference because Chaloner-Gill et al. fail to disclose a battery having an ion pair wherein one member of the pair is covalently attached to the polymer backbone while the other is capable of diffusing through the polymer electrolyte upon the application of

an electric field. Rather, they simply disclose a conventional "two ion" polymer electrolyte.

Claim 70, as well as dependent claim 71, are directed to an electrolytic cell which comprises a covalently cross-linked polymer single ion electrolyte which has limitations much like those of the polymer electrolyte of claim 66. Accordingly, claim 70, as well as all claims depending therefrom, is submitted as patentable over the cited reference for the same reasons as those set forth with respect to claim 66.

III. Rejections under 35 U.S.C. §103

Reconsideration of the present rejections under 35 U.S.C. §103 is respectfully requested.

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the reference itself or in the knowledge generally available to one of ordinary skill in the art, to modify the reference. Second, there must be a reasonable expectation of success. And third, the prior art reference must teach or suggest all of the claim limitations. MPEP §2142. In the instant case, Applicants respectfully submit, for the reasons set forth in detail below, that the claimed inventions are not obvious in view of the cited references, because these references, both alone and in combination, fail to disclose or suggest all of the claim limitations.

A. Rejection of Claims 2 and 3 as being Unpatentable over Harris et al. or Takahashi et al. in view of U.S. Patent No. 5,643,665

Reconsideration is respectfully requested of the rejection of claims 2 and 3 under 35 U.S.C. §103 as being unpatentable over Harris et al. or Takahashi et al. in view of U.S. Patent No. 5,643,665 (hereinafter "Saidi").[2]

Claim 1, from which claims 2 and 3 depend, is directed to a covalently cross-linked polymer electrolyte. The polymer electrolyte comprises a polymer backbone containing amine groups, a cross-linker, and a dissolved or dispersed metal salt therein, the cross-linked polymer electrolyte being inert to lithium.

Harris et al. fail to disclose or suggest a polymer electrolyte that is covalently cross-linked. In fact, they fail to even reference cross-linking. Accordingly, they also fail to disclose or suggest a covalently cross-linked polymer electrolyte which comprises amine groups in the polymer backbone and which is inert to lithium. Rather, Harris et al. disclose only branched and linear polyethylenimine.

Takahashi et al. fail to disclose or suggest a covalently cross-linked polymer electrolyte which comprises amine groups in the polymer backbone and which is inert to lithium. Rather, Takahashi et al. cross-link linear polyethylenimine using 1,2,7,8-diepoxyoctane. As noted in the present specification on page 20, lines 3-8, diepoxides, as a result of the cross-linking reaction, form an alcohol functionality, which are reducible by lithium.

Saidi fails to disclose or suggest a covalently cross-linked polymer electrolyte which contains amine groups in the polymer backbone and which is inert to lithium.

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[2] Although Paul (U.S. Patent No. 5,501,919) is also references in the text on page 14, it is noted that this patent is not cited in paragraph 12 of the rejection. Accordingly, it will not be address specifically herein. However, it is to be noted that Applicants respectfully submit the addition of Paul to the cited combination of references does not render the rejected claims obvious.

Saidi does disclose polymer electrolytes, which may *optionally* have amine groups in the polymer backbone. Saidi also generally references the *optional* cross-linking of polymer electrolytes. Notably, however, Saidi does not specifically disclose or suggest the formation of a cross-linked polymer electrolyte having amine groups in the polymer backbone which is inert to lithium. Furthermore, Saidi does not specifically reference a cross-linker that would be suitable for use with a polymer having amine groups in the polymer backbone, in order to obtain a cross-linked polymer that is inert to lithium.

Accordingly, taken together, Harris et al. and Takahashi et al. fail to disclose or suggest all of the claim limitations of claim 1, and thus of claims 2 and 3, in as much as these references fail to disclose or suggest a cross-linked polymer electrolyte which comprises amines in the polymer backbone and which is inert to lithium. The addition of Saidi does not change this result, in as much as Saidi also fails to disclose a cross-linker suitable for use in an amine-containing polymer, such that the resulting cross-linked polymer electrolyte is inert to lithium. Furthermore, Saidi fails to provide any motivation to one of ordinary skill in the art to modify the combined teachings of Harris et al. and Takahashi et al. in order to obtain such a polymer electrolyte.

In view of the foregoing, claim 1 is submitted as patentable over the cited references. In as much as claims 2 and 3 depend from claim 1, these claims are submitted as patentable over the cited references for at least the same reasons as those noted with respect to claim 1. Although these claims include additional patentable features, these features will not be addressed at this time in the interests of brevity.

B. Rejection of Claims 23, 24, 26 and 29 as being Unpatentable over U.S. Patent No. 5,501,919 in view of U.S. Patent No. 5,648,186

Reconsideration is respectfully requested of the rejection of claims 23, 24, 26 and 29 under 35 U.S.C. §103 as being unpatentable over U.S. Patent No. 5,501,919 (Paul et al.) in view of U.S. Patent No. 5,648,186 (Daroux et al.).

As previously noted, claim 1, from which claims 23, 24, 26 and 29 depend, is directed to a covalently cross-linked polymer electrolyte. The polymer electrolyte comprises a polymer backbone containing amine groups, a cross-linker, and a dissolved or dispersed metal salt therein, the cross-linked polymer electrolyte being inert to lithium.

Paul et al. fail to disclose or suggest a polymer electrolyte that is covalently <u>cross-linked</u>. In fact, they fail to even reference cross-linking. Accordingly, they also fail to disclose or suggest a covalently cross-linked electrolyte which is <u>inert to lithium</u>. Rather, Paul et al. simply disclose the preparation of branched polyethylenimine which has a lithium salt therein.

Daroux et al. also fail to disclose or suggest a covalently cross-linked polymer electrolyte which is <u>inert to lithium</u>. Rather, Daroux et al. disclose dendrimers of, for example, polyethylenimine, derivatized by growing ethylene oxide arms therefrom (see, e.g., column 7, lines 16-20). Elsewhere, they *generally* disclose the *optional* cross-linking of dendrimers (see, e.g., column 6, lines 25-31). However, the only specific details provided with respect to cross-linking involve the use of hexamethylene diisocyanate (see, e.g., column 7, lines 16-20, as well as Examples 2, 4, 12 and 13). Cross-linking using diisocyanates is known to result in the formation of urethane linkages or functionalities, which are reducible by lithium.

Accordingly, taken together, Paul et al. and Daroux et al. fail to disclose or suggest all of the claim limitations of claim 1, and thus of claims 23, 24, 26 and 29, in as much as these references fail to disclose or suggest a cross-linked polymer electrolyte which comprises a polymer backbone containing amine groups and which is inert to lithium. Claim 1 is therefore submitted as patentable over the cited references. In as much as claims 23, 24, 26 and 29 depend from claim 1, these claims are submitted as patentable over the cited references for at least the same reasons as those noted with respect to claim 1. Although these claims include additional

patentable features, these features will not be addressed at this time in the interests of brevity.

C. Rejection of Claim 15 as being Unpatentable over U.S. Patent No. 5,964,903 in view of U.S. Patent No. 5,300,374

Reconsideration is respectfully requested of the rejection of claim 15 under 35 U.S.C. §103 as being unpatentable over U.S. Patent No. 5,964,903 (Gao et al.) in view of U.S. Patent No. 5,300,374 (Agrawal et al.).[3]

As previously noted, claim 1, from which claim 15 depends, is directed to a covalently cross-linked polymer electrolyte. The polymer electrolyte comprises a polymer backbone containing amine groups, a cross-linker, and a dissolved or dispersed metal salt therein, the cross-linked polymer electrolyte being inert to lithium.

Gao et al. fail to disclose or suggest a polymer electrolyte that is covalently cross-linked. In fact, they fail to even reference cross-linking. Accordingly, they also fail to disclose or suggest a covalently cross-linked electrolyte which is inert to lithium. Rather, Gao et al. simply disclose plasticizers which are suitable for use in fabricating electrochemical cells (see, e.g., column 1, line 65 to column 2, line 4).

Agrawal et al. fail to disclose or suggest a covalently cross-linked polymer electrolyte which comprises amine groups in the polymer backbone and which is inert to lithium. Although Agrawal et al. generally reference block copolymers, which could include a copolymer having a block of polyethylenimine therein, they express a clear preference for block copolymers of polyethylene oxide and polypropylene oxide (see, e.g., column 3, lines 10-28). Furthermore, although cross-linking is also *generally* referenced, again there is a clear preference for the cross-linking of block copolymers of polyethylene oxide and polypropylene oxide (see, e.g., column 3, lines 26-28 and the

[3] Paragraph 14 of the present rejection (page 16) cites Gao et al. in combination with Agrawal et al. It is noted, however, that the text accompanying this rejection makes no specific reference to the relevant teaching of Gao et al.

Examples). Finally, the only specific reference to a cross-linker is provided in the working examples, wherein diepoxides are used. As previously noted, diepoxides, as a result of the cross-linking reaction, form alcohol functionalities which are reducible by lithium.

Accordingly, taken together, Gao et al. and Agrawal et al. fail to disclose or suggest all of the claim limitations of claim 1, and thus of claim 15, in as much as these references fail to disclose or suggest a cross-linked polymer electrolyte which comprises amines in the polymer backbone and which is inert to lithium. Claim 1 is therefore submitted as patentable over the cited references. In as much as claim 15 depends from claim 1, it is submitted as patentable over the cited references for at least the same reasons as those noted with respect to claim 1. Although this claim includes additional patentable features, these will not be addressed at this time in the interests of brevity.

D. Rejection of Claims 23, 26, 28 and 29 as being Unpatentable over U.S. Patent No. 5,501,919 in view of U.S. Patent No. 6,096,453

Reconsideration is respectfully requested of the rejection of claims 23, 26, 28 and 29 under 35 U.S.C. §103 as being unpatentable over U.S. Patent No. 5,501,919 (Paul et al.) in view of U.S. Patent No. 6,096,453 (Grunwald et al.).[4]

As previously noted, claim 1, from which claims 23, 26, 28 and 29 depend, is directed to a covalently cross-linked polymer electrolyte. The polymer electrolyte comprises a polymer backbone containing amine groups, a cross-linker, and a dissolved or dispersed metal salt therein, the cross-linked polymer electrolyte being inert to lithium.

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[4] Paragraph 15 of the present rejection (page 17) cites Paul et al. in combination with Grunwald et al. It is noted, however, that the text accompanying this rejection (page 18) references Daroux et al. Since it appears these references were intended to be to Grunwald et al., this response will proceed in that manner.

Paul et al. fail to disclose or suggest a polymer electrolyte that is covalently cross-linked. In fact, they fail to even reference cross-linking. Accordingly, they also fail to disclose or suggest a covalently cross-linked electrolyte which is inert to lithium. Rather, Paul et al. simply disclose the preparation of branched polyethylenimine which has a lithium salt therein.

Grunwald et al. fail to disclose or suggest a covalently cross-linked polymer electrolyte which comprises amine groups in the polymer backbone and which is inert to lithium. Grunwald et al. generally reference numerous polymers, copolymers, etc., some of which would include amines in the polymer backbone (see, e.g., column 4, lines 40 to column 5, line 58). They also reference cross-linked polymers, which could include polymers having amines in the polymer backbone (see, e.g., column 10, lines 49-60). However, it is to be noted that, although cross-linking is referenced, few details are provided with respect to the cross-linkers that may be used. Furthermore, there is no reference to cross-linkers that could be employed with a polymer having amine groups in the backbone, in order to yield a cross-linked polymer which is inert to lithium.

Accordingly, taken together, Paul et al. and Grunwald et al. fail to disclose or suggest all of the claim limitations of claim 1, and thus of claims 23, 26, 28 and 29, in as much as these references fail to disclose or suggest a cross-linked polymer electrolyte which comprises amines in the polymer backbone and which is inert to lithium. Claim 1 is therefore submitted as patentable over the cited references. In as much as claims 23, 26, 28 and 29 depend from claim 1, these claims are submitted as patentable over the cited references for at least the same reasons as those noted with respect to claim 1. Although these claims include additional patentable features, these will not be addressed at this time in the interests of brevity.

E. Rejection of Claims 20-22 and 26-29 as being Unpatentable over U.S. Patent No. 5,501,919 in view of U.S. Patent No. 5,964,903.

Reconsideration is respectfully requested of the rejection of claims 20-22 and 26-29 under 35 U.S.C. §103 as being unpatentable over U.S. Patent No. 5,501,919 (Paul et al.) in view of U.S. Patent No. 5,964,903 (Gao et al).

As previously noted, claim 1, from which claims 20-22 and 26-29 depend, is directed to a covalently cross-linked polymer electrolyte. The polymer electrolyte comprises a polymer backbone containing amine groups, a cross-linker, and a dissolved or dispersed metal salt therein, the cross-linked polymer electrolyte being inert to lithium.

Both Paul et al. and Gao et al. fail to disclose or suggest a polymer electrolyte that is covalently cross-linked. In fact, they fail to even reference cross-linking. Accordingly, they also fail to disclose or suggest a covalently cross-linked electrolyte which is inert to lithium. Rather, Paul et al. simply disclose the preparation of branched polyethylenimine which has a lithium salt therein, while Gao et al. simply disclose plasticizers which are suitable for use in fabricating electrochemical cells.

Accordingly, taken together, Paul et al. and Gao et al. fail to disclose or suggest all of the claim limitations of claim 1, and thus of claims 20-22 and 26-29, in as much as these references fail to disclose or suggest a cross-linked polymer electrolyte which comprises amines in the polymer backbone and which is inert to lithium. Claim 1 is therefore submitted as patentable over the cited references. In as much as claims 20-22 and 26-29 depend from claim 1, these claims are submitted as patentable over the cited references for at least the same reasons as those noted with respect to claim 1. Although these claims include additional patentable features, these will not be addressed at this time in the interests of brevity.

CONCLUSION

In view of the foregoing, favorable reconsideration and allowance of all pending claims are respectfully requested.

Applicants hereby request an extension of time to and including April 20, 2004 for filing a response to the above-referenced Office action. A check in the amount of $511.00, in payment of the applicable 3 month extension fee and extra claim fees, is enclosed herewith.

The Commissioner is hereby authorized to charge any underpayment or credit any overpayment to Deposit Account No. 19-1345.

Respectfully submitted,

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*Enclosure